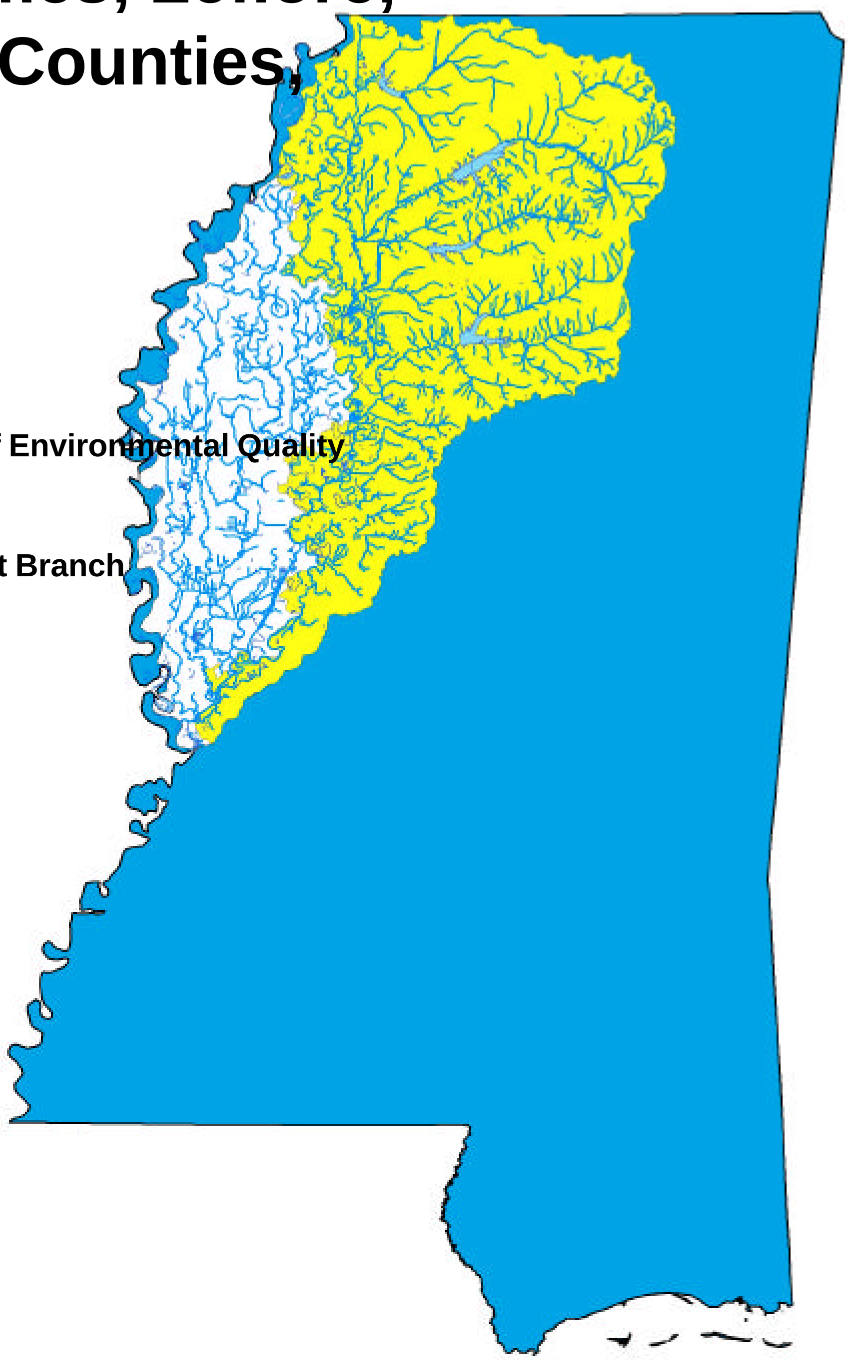
PROPOSED
June 2003

Fecal Coliform TMDL for the Yazoo River

Yazoo River Basin

Carroll, Holmes, Leflore, and Warren Counties, Mississippi



Prepared By

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FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. The report contains one or more Total Maximum Daily Loads (TMDLs) for waterbody segments found on Mississippi's 1996 Section 303(d) List of Impaired Waterbodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Prefixes for fractions and multiples of SI units

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

Conversion Factors

To convert from	To	Multiply by	To Convert from	To	Multiply by
Acres	Sq. miles	0.0015625	Days	Seconds	86400
Cubic feet	Cu. Meter	0.028316847	Feet	Meters	0.3048
Cubic feet	Gallons	7.4805195	Gallons	Cu feet	0.133680555
Cubic feet	Liters	28.316847	Hectares	Acres	2.4710538
cfs	Gal/min	448.83117	Miles	Meters	1609.344
cfs	MGD	.6463168	Mg/l	ppm	1
Cubic meters	Gallons	264.17205	μg/l * cfs	Gm/day	2.45

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TMDL INFORMATION PAGE

Listing Information

Name	ID	County	HUC	Cause	Mon/Eval
Yazoo River	MSYAZR3M1	Leflore, Carroll, and Holmes	08030206	Pathogens	Monitored
Near Shell Bluff: From confluence of Tallahatchie and Yalobusha Rivers to Belzoni (Hwy 12)					
Yazoo River	MS400M	Warren	08030208	Pathogens	Evaluated
At Redwood: From Anderson Tully Outfall to confluence with Steele Bayou					

Water Quality Standard

Parameter	Beneficial use	Water Quality Criteria
Fecal Coliform	Secondary Contact	**May - October**: Fecal coliform colony counts not to exceed a geometric mean of 200 per 100ml based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 per 100ml more than 10 percent of the time. **November – April**: Fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4000 per 100 ml more than 10 percent of the time.

NPDES Facilities

NPDES ID	Facility Name	Receiving Water
MS0020371	Belzoni POTW	Yazoo River
MS0043346	Confish Inc	Yazoo River
MS0042315	Cruger POTW	Abiacha Creek
MS0040185	East Leflore County Water and Sewer District POTW, Chapman Subdivision	Jennings Bayou
MS0022705	East Leflore County Water and Sewer District, Rising Sun Subdivision	Pelucia Creek
MS0029203	Florewood State Park	Yazoo River
MS0048551	Freshwater Farms Inc	Yazoo River
MS0023833	Greenwood POTW	Yazoo River
MS0022594	Holmes County School District, Mileston Elementary School	Tchula Lake
MS0032620	Holmes County School District, Tchula and S V Marshall Attendance Center	Fannegusha Creek
MS0048003	Humphreys Academy Foundation, Humphreys Academy	Unnamed Ditch
MS0020915	Itta Bena POTW	Gayden Brake
MS0024601	Lexington POTW	Little Black Creek
MS0034169	Malouf Trailer Park	Pelucia Canal
MS0042641	Maryland Heights Trailer Park	Yazoo River
MS0024716	Morgan City Water and Sewer Association	Yazoo River
MS0024741	North Carrollton POTW	Big Sand Creek
MS0058301	Salvation Army, The, Camp Hidden Lake	Black Creek
MS0024724	Sidon POTW	Old Yazoo River
MS0044709	Silver City POTW	Big Cedar Creek
MS0057304	Southwest Developments Corporation, Rosebank Apartments	Fenneshuga Creek

NPDES Facilities, continued

NPDES ID	Facility Name	Receiving Water
MS0051098	T T and W Farm Products Inc	Yazoo River
MS0021482	Tchula POTW	Yazoo River
MS0043982	Tepper Headstart	Little Jackson Bayou
MS0030431	Vicksburg Warren School District, Redwood Elementary	Skillikalia Bayou
MS0020389	Yazoo City POTW	Yazoo River
MS0050261	Yazoo County High School	Short Creek

Total Maximum Daily Load, MSYAZR3M1 and MS400M

Segment	WLA (counts per day)	LA (counts per day)	MOS	TMDL Percent Reduction
MSYAZR3M1	1.61E+11	Varies with Flow	Explicit	40
MS400M	2.66E+11	Varies with Flow	Explicit	39

EXECUTIVE SUMMARY

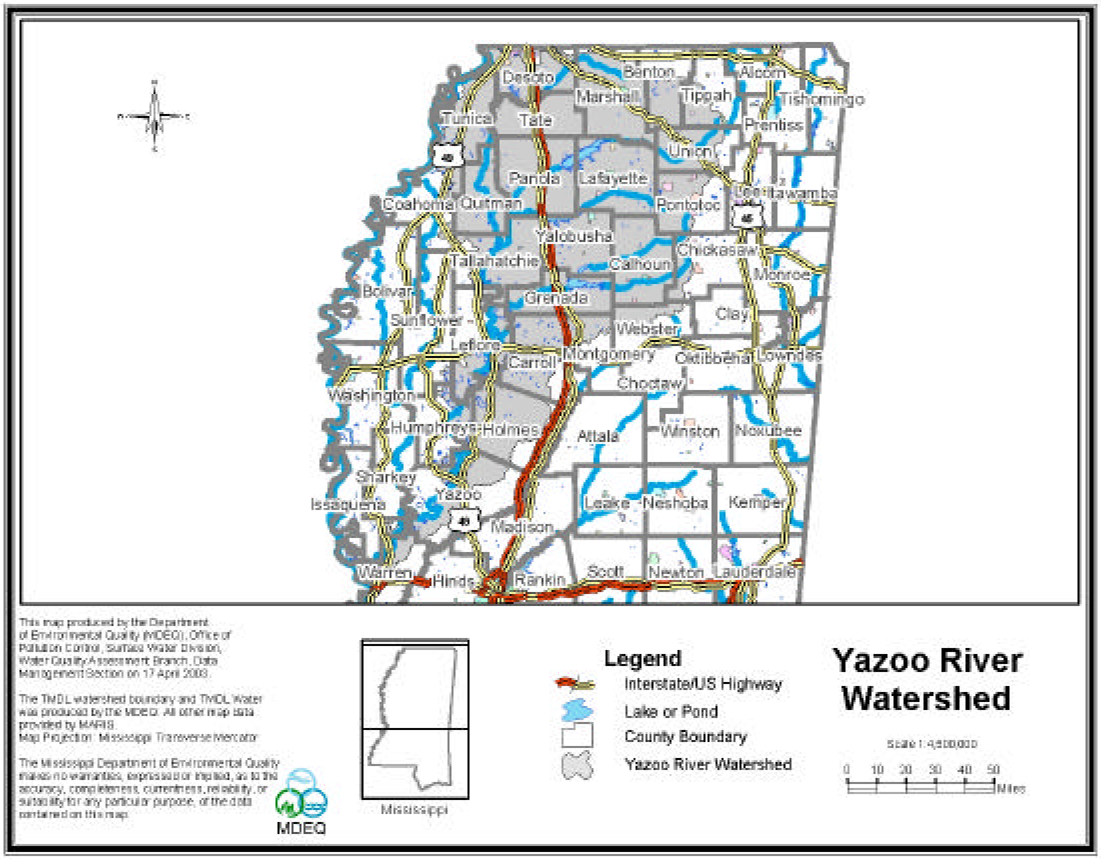
Two segments of the Yazoo River are on the Mississippi 1998 Section 303(d) List of Waterbodies as monitored and evaluated waterbody segments, due to pathogens. MDEQ selected fecal coliform as an indicator organism for pathogenic bacteria. The applicable state standard specifies that for the months of May through October, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 200 colonies per 100 ml based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed a colony count of 400 per 100 ml more than 10 percent of the time. For the months of November through April, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed a colony count of 4000 per 100 ml more than 10 percent of the time.

Photo 1. Yazoo River

The Yazoo River, Photo 1 and Figure 1, flows in a southwesterly direction from the confluence of the Tallahatchie and Yalobusha Rivers near Greenwood, Mississippi to the Mississippi River. The Yazoo River is the largest stream flowing through the Yazoo River Basin. This TMDL has been developed for two listed segments of the Yazoo River. Due to complex hydrological factors of the Yazoo River, the BASINS Nonpoint Source Model (NPSM) was inappropriate as the modeling framework for performing the TMDL allocations for this study. Load duration curves, which compare the water quality data against a flow-varying allowable load, were used to determine the TMDL.

Although fecal coliform loadings from point and nonpoint sources in the watershed were not explicitly represented with a model, a source assessment was conducted for the Yazoo River Watershed. Nonpoint sources considered include wildlife, livestock, and urban development. Also considered were the nonpoint sources such as failing septic systems and other direct inputs to tributaries of the Yazoo River. There are 27 NPDES Permitted discharges included as point sources in the waste load allocation (WLA).

Figure 1. Location of the Yazoo River Watershed



Most of the permitted facilities currently have requirements in their NPDES Permits that require disinfection to meet water quality standards for pathogens at the end of pipe. Therefore, no changes are required for those existing NPDES permits. However, this TMDL recommends that upon permit reissuance the other NPDES Permits be modified to require disinfection. Monitoring of the permitted facilities in the Yazoo River Watershed should continue to ensure that compliance with permit limits is consistently attained.

The seasonal variations in hydrology, climatic conditions, and watershed activities are represented through the use of a continuous gage to develop the acceptable load curve and the use of water quality data collected throughout the year. The critical period was determined to be the summer season of May through October. An explicit 50 percent margin of safety (MOS) was used to account for uncertainty in the load duration curve method.

Water quality data indicate violations of the fecal coliform standard in the waterbody. The load duration curves provide a data-based method to estimate the reductions required to meet water quality standards in the Yazoo River. Load duration curves and TMDLs were computed at two locations corresponding to the impaired segments of the Yazoo River. The estimated reduction of fecal coliform bacteria required for segment MSYAZR3M1 is 40% and for segment MS400M is 39%.

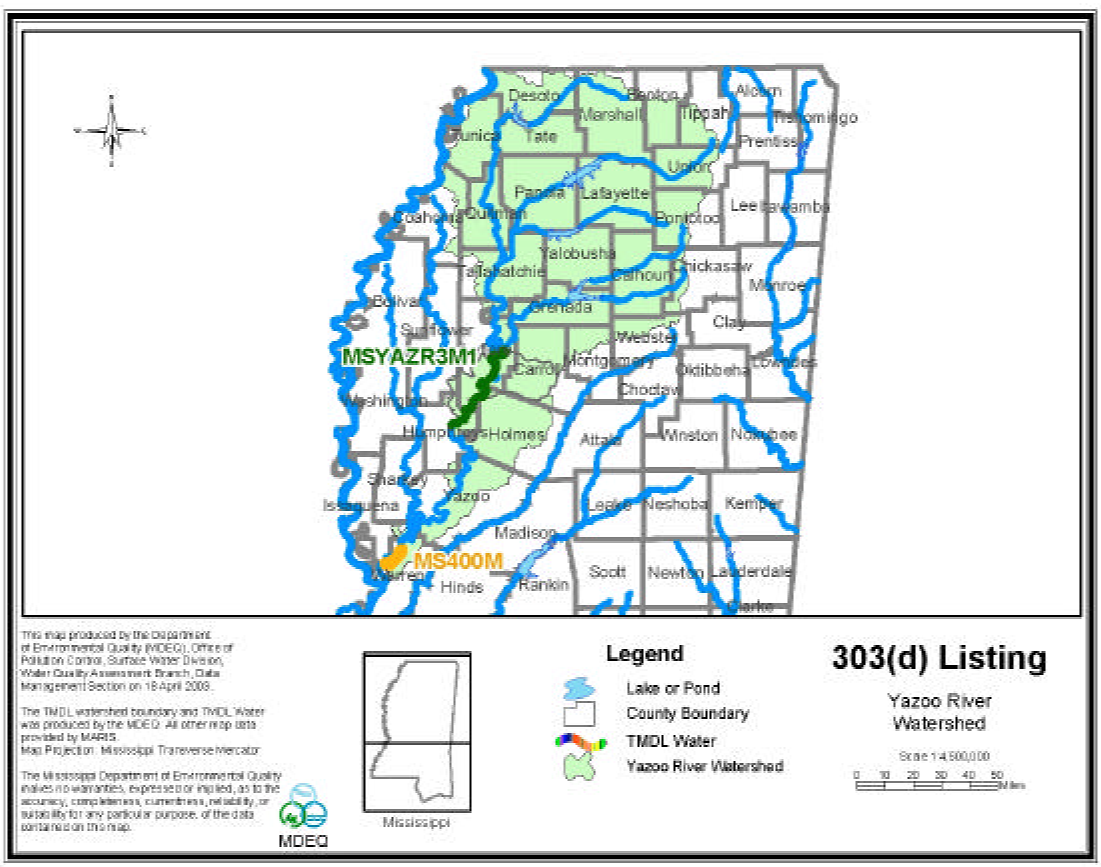
INTRODUCTION

1.1 Background

The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is fecal coliform. Fecal coliform bacteria are used as indicator organisms. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from nonpoint sources, maintain permit requirements for point sources, and restore and maintain the quality of water resources.

One segment, MSYAZR3M1, of the Yazoo River is on the monitored section of the Mississippi 1998 Section 303(d) List of Waterbodies for pathogen impairment. One segment, MS400M, is on the evaluated section of the Mississippi 1998 Section 303(d) List of Waterbodies for pathogen impairment. These segments were listed based on current and historical data. The 303d listed segments are shown in Figure 2.

Figure 2. Yazoo River Watershed 303d Listed Segments



Load duration curves are developed using water quality monitoring data along with long-term flow monitoring data, typically from the station where the sampling data were collected. However, when flow data are not available at the monitoring station, a nearby station can be used. The 303d listed segments along with the locations of the water quality and flow gages are shown in Figures 3 and 4. The TMDL for segment MS400M was developed with one load duration curve based on water quality data from station 07288800 and limited flow data from the same station. Flow and fecal data from station 07288955 was not used to develop the TMDL as the station is below the end of the impaired segment and includes the influence of the Big Sunflower River which flows into the Yazoo River downstream of the impaired segment. The TMDL for segment MSYAZR3M1 was developed with a load duration curve based on water quality data from station 07287120 and flow data from station 07287000 using a drainage area ratio method. Monthly seasonal data were collected from station 28 but were not used in the load duration curve analysis.

Figure 3. MS400M 303d Listed Segment with Water Quality and Flow Gages

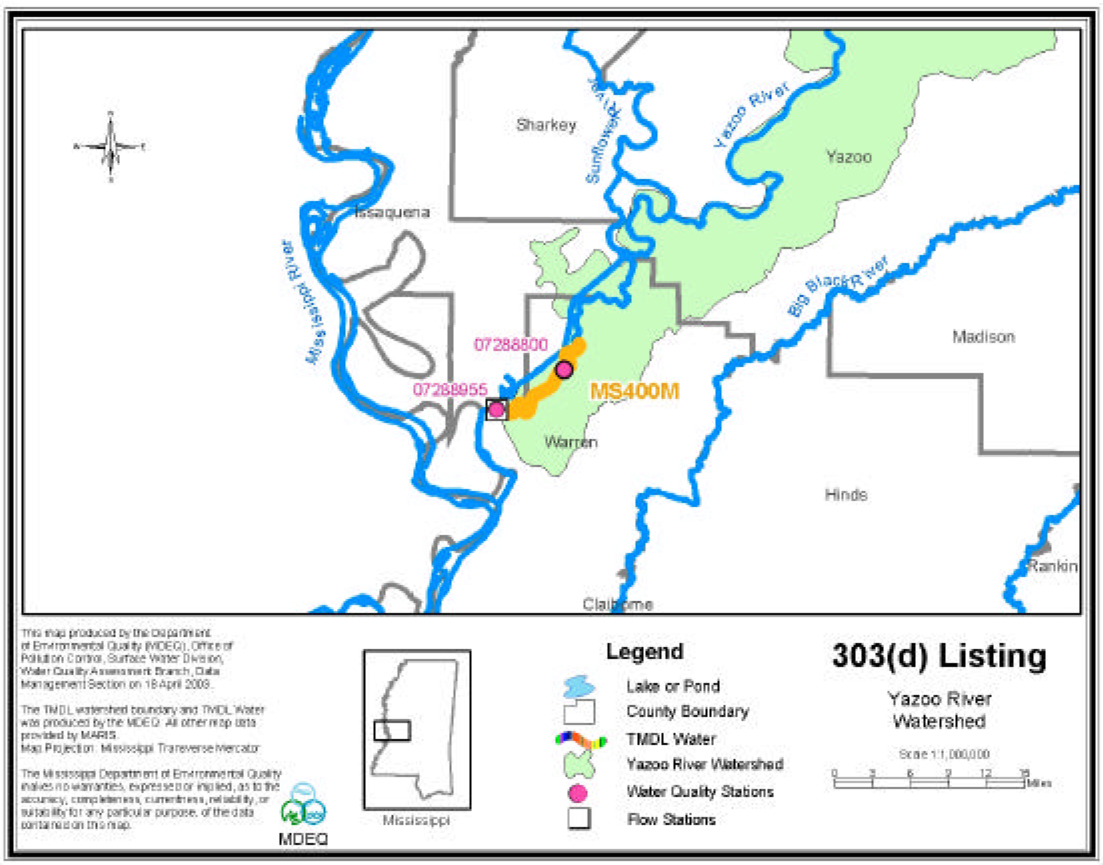
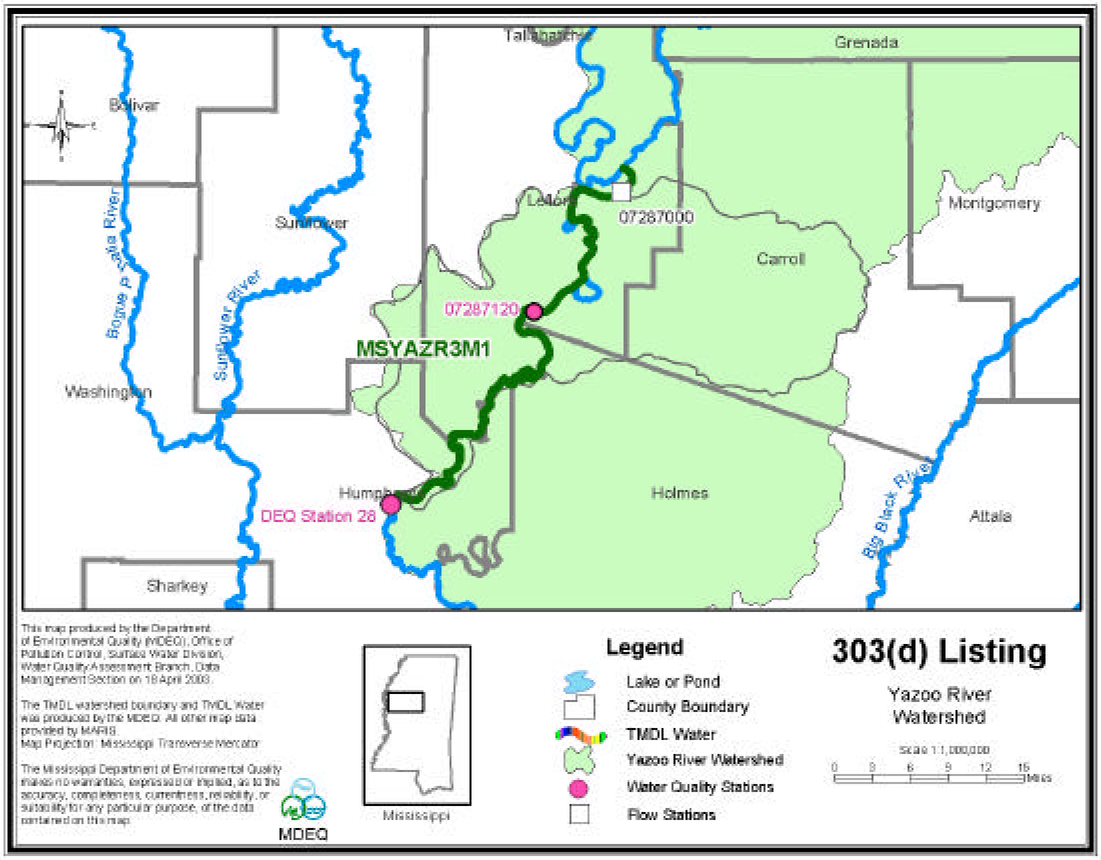


Figure 4. MSYAZR3M1 303d Listed Segment with Water Quality and Flow Gages



The Yazoo River segments are in the Yazoo River Basin Hydrologic Unit Code (HUC) 08030207 in northwest Mississippi. The watershed is approximately 5,206,000 acres. The watershed is primarily rural, but includes many small municipalities. Pasture, cropland, and forest are the dominant landuses within the watershed as shown by the land distribution summary in Table 1.

Table 1. Landuse Distribution for the Yazoo River Watershed

	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Other	Total
Area (acres)	31,128	1,336,969	1,456,546	1,880,717	5,231	338,501	5,335	128,335	22,792	5,205,555
% Area	1%	26%	28%	36%	0%	7%	0%	2%	0%	100%

1.2 Applicable Waterbody Segment Use

The water use classification for the listed segments of the Yazoo River, as established by the State of Mississippi in the *Water Quality Criteria for Intrastate, Interstate and Coastal Waters* regulation, is Fish and Wildlife Support. The designated beneficial uses for the Yazoo River are Secondary Contact and Aquatic Life Support.

1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the water body and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (2002). The standard states that for the summer months the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 per 100 ml more than 10 percent of the time. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4000 per 100 ml more than 10 percent of the time. The water quality standard was used to assess the data to determine impairment in the waterbody. The instantaneous, summer portion of the water quality standard, 400 counts per 100 ml, was used as the targeted endpoint to establish these TMDLs using the load duration curve method.

TMDL ENDPOINT AND WATER QUALITY ASSESSMENT

2.1 Selection of a TMDL Endpoint and Critical Condition

One of the major components of a TMDL is the establishment of instream numeric endpoints, which are used to evaluate the attainment of acceptable water quality. Instream numeric endpoints, therefore, represent the water quality goals that are to be achieved by implementing the load and waste load reductions specified in the TMDL. The endpoints allow for a comparison between observed instream conditions and conditions that are expected to restore designated uses. The instream fecal coliform target for this TMDL is 400 colony counts per 100 ml with an explicit MOS of 50 percent, which reduces the target to 200 colony counts per 100 ml.

While the endpoint of a TMDL calculation is similar to a standard for a pollutant, the endpoint is not the standard. Currently MDEQ's standard for fecal coliform states that for the summer months the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 400 per 100 ml more than 10 percent of the time. For the winter months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 2000 colonies per 100 ml, based on a minimum of 5 samples taken over a 30-day period with no less than 12 hours between individual samples, nor shall the samples examined during a 30-day period exceed 4000 per 100 ml more than 10 percent of the time. For these TMDLs, MDEQ considered the instantaneous portion of the standard when looking at the data for assessment of impairment, setting the target, and calculating the TMDL. The geometric mean portion of the standard is not appropriate as a target for use with load duration curves at this time because the data available at stations with the appropriate flow information are instantaneous. Data appropriate for the calculation of geometric means have been recently collected on the Yazoo River at station 28 and are provided in Section 2.2.

Because fecal coliform may be attributed to both nonpoint and point sources, the critical condition used for the evaluation of stream response was derived by a multi-year period. Critical conditions for waters impaired by nonpoint sources generally occur during periods of wet-weather and high surface runoff. But, critical conditions for point source dominated systems generally occur during low-flow, low-dilution conditions. Figure 5 shows the water quality data and the corresponding precipitation data for Station 28 on segment MSYAZR3M1. Figure 6 shows the water quality data from 1997 through 2000 and the corresponding precipitation data for Station 07287120 on segment MSYAZR3M1. The critical condition for segment MSYAZR3M1 appears to be summer and wet weather. Figure 7 shows the water quality data from 1976 through 1993 and the corresponding precipitation data for Station 07288800 on segment MS400M. The critical condition for segment MS400M appears to be summer and wet weather. The 400 counts per 100 ml standard was applied to all of the data in the load duration curves.

Figure 5. Water Quality Data from Station 28 and Rainfall

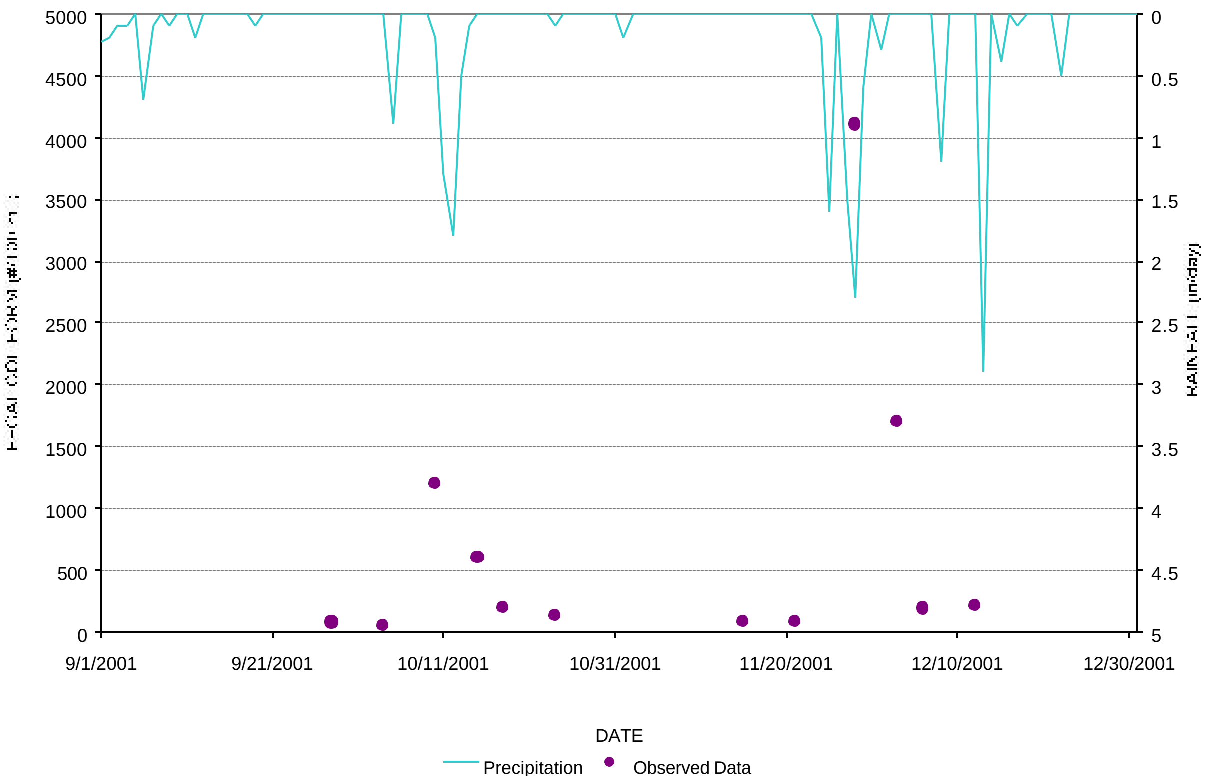


Figure 6. Water Quality Data from Station 07287120 and Rainfall

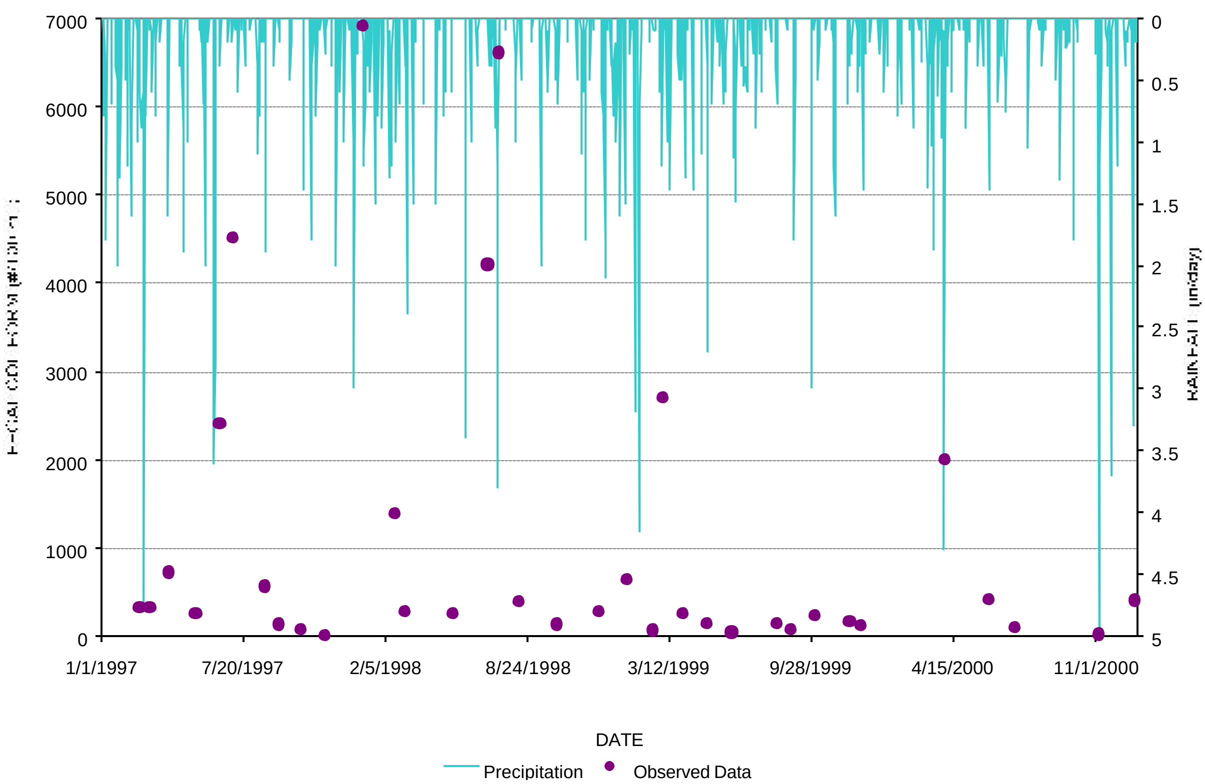
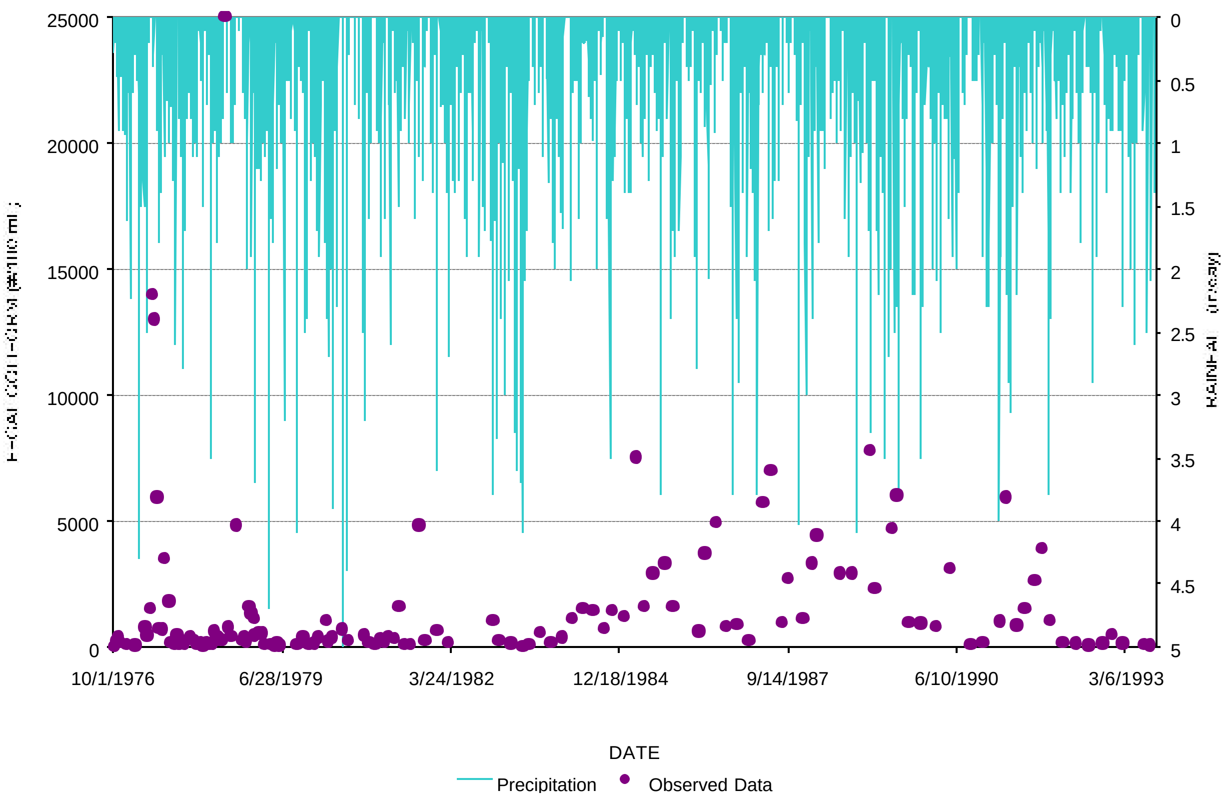


Figure 7. Water Quality Data from Station 07288800 and Rainfall



2.2 Discussion of Instream Water Quality

USGS collected data at two stations (07287120 and 07288800) in the listed segments during the evaluation period. MDEQ collected data at station 28. Monitoring for flow and fecal coliform was performed on a routine basis at station 07288000, which is located at Redwood for segment MS400M. For segment MSYAZR3M1, monitoring for flow and fecal coliform was performed on a routine basis at station 07287120 and seasonal monthly monitoring was performed at station 28.

USGS no longer gathers routine fecal monitoring data at these stations. In order to gather fecal coliform data, MDEQ now goes to monitoring stations six times within a 30-day period. These data are used to calculate the geometric mean for the waterbody. The Yazoo River was recently included in this type of monitoring.

2.2.1 Inventory of Available Water Quality Monitoring Data

The data collected at the monitoring stations are provided in Tables 2, 3, and 4.

Table 2. Fecal Coliform Data at Station 07288800 for segment MS400M

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
10/13/1976	11:00	9490	20
10/21/1976	9:00	10200	250
11/6/1976	15:00	10400	400
11/16/1976	11:00	7760	130
12/20/1976	12:00	11600	60
2/15/1977	11:00		30
4/13/1977	11:00	29200	740
4/27/1977	10:00	26000	440
5/10/1977	11:00	14100	1500
5/27/1977	11:30	10500	14000
6/7/1977	12:00	6240	13000
6/22/1977	11:00		5900
7/7/1977	10:00		720
7/21/1977	9:00	8530	670
8/3/1977	10:00	12700	3500
9/1/1977	11:00	8060	1800
9/15/1977	12:30	12400	150
10/4/1977	14:00	14000	94
10/20/1977	10:00	19400	420
11/1/1977	10:30	15800	100
12/1/1977	10:00	30200	120
12/14/1977	10:00	27600	210
1/4/1978	14:00	21900	380
1/31/1978	13:00	38500	230
2/13/1978	12:00	35100	110
3/7/1978	14:00	25500	130
3/23/1978	10:00	7000	31
4/12/1978	12:30	6300	110
4/27/1978	9:30	20000	50
5/16/1978	14:00	35000	120
5/31/1978	11:30	30000	600
6/13/1978	14:30	26900	370
6/27/1978	10:00	14800	260
7/11/1978	11:00	15900	230
8/1/1978	13:00	15600	25000
8/16/1978	13:00	16100	760
9/6/1978	12:30	12000	390
10/3/1978	16:00	12000	4800
11/7/1978	14:30	9700	230
11/20/1978	13:30	7800	350
12/4/1978	11:00	9200	180
12/20/1978	13:30	12000	1600
1/3/1979	12:00	25000	1300
1/17/1979	13:00	23000	430
1/22/1979	12:30	38800	1100
2/20/1979	13:00	22900	520

Table 2. Continued

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
3/6/1979	16:00	22000	500
3/22/1979	13:00	19800	69
5/1/1979	17:00	26000	52
5/16/1979	13:30	40000	29
6/5/1979	16:00	34200	140
6/18/1979	14:00	22000	44
10/2/1979	13:00	11000	62
11/6/1979	15:00	13300	400
12/11/1979	14:00	20200	87
1/8/1980	14:30	20400	120
2/5/1980	13:30	22300	350
3/18/1980	14:00	34600	1000
4/4/1980	10:00	35000	180
4/28/1980	15:00	39500	370
6/27/1980	14:30	28900	680
7/29/1980	10:30	27300	230
11/3/1980	12:30	14200	440
12/1/1980	11:00	19100	140
1/6/1981	10:00	3370	100
2/3/1981	11:00	14200	310
2/25/1981	11:00	6710	160
3/25/1981	13:00	4610	410
4/28/1981	14:00	1280	310
5/28/1981	10:00	14000	1600
6/24/1981	15:30	1200	69
7/29/1981	13:30	8130	66
9/22/1981	15:00	8360	4800
10/29/1981	14:00	7700	240
1/6/1982	14:30	9000	640
3/10/1982	13:00	9840	130
12/6/1982	11:00	35700	1000
1/11/1983	14:00		240
3/23/1983	13:00	31000	110
6/1/1983	11:00	37000	11
7/6/1983	15:30	20300	100
9/7/1983	14:30	15100	570
11/16/1983	13:00	13200	160
1/17/1984	15:00	30700	370
3/19/1984	12:30	28900	1100
5/22/1984	12:00	15600	1500
7/18/1984	11:30	15500	1400
9/26/1984	13:30		700
11/9/1984	14:00	11900	1400
1/23/1985	11:00		1200
3/28/1985	14:00		7500
5/20/1985	12:30		1600

Table 2. Continued

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
7/11/1985	10:30		2900
9/18/1985	14:00	7690	3300
11/5/1985	12:30	14700	1600
4/10/1986	12:00	3370	580
5/14/1986	12:00		3700
7/16/1986	12:00	3430	4900
9/17/1986	10:00	8910	780
11/19/1986	11:00	19100	860
1/28/1987	13:00	22800	230
4/22/1987	10:30	6300	5700
6/11/1987	13:00	1000	7000
8/13/1987	12:00	3440	920
9/16/1987	11:00	5080	2700
12/14/1987	15:00	6990	1100
2/10/1988	9:00		3300
3/10/1988	10:00	14100	4400
7/19/1988	10:30	5550	2900
9/28/1988	11:15	2800	2900
1/19/1989	12:30	32000	7800
2/15/1989	11:00	24000	2300
5/24/1989	11:00	22100	4700
6/22/1989	14:00	37800	6000
9/5/1989	11:30	16900	920
11/14/1989	14:30		900
2/12/1990	14:00	27000	810
5/2/1990	13:30	17100	3100
9/6/1990	9:30	9590	87
11/15/1990	11:30	8800	160
2/27/1991	13:00	30400	980
4/4/1991	12:00	24400	5900
6/5/1991	13:00	41000	820
7/22/1991	14:00	15900	1500
9/20/1991	13:30	15400	2600
11/4/1991	13:00	11800	3900
12/19/1991	13:30	29900	1000
3/3/1992	13:15	13900	170
5/18/1992	11:45	3280	110
8/5/1992	11:20		33
10/28/1992	14:00	8740	110
12/21/1992	15:30	15500	450
2/23/1993	13:30	11800	120
6/28/1993	13:00	9910	80
8/3/1993	10:30		30

Table 3. Fecal Coliform Data at Station 07287120 for segment MSYAZR3M1

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
1/8/75	13:00	20000	390
2/5/75	12:00	28000	10000
3/5/75	13:00	27500	230
4/2/75	12:30	26500	3900
5/13/75	10:30	24000	2500
6/9/75	18:00	16000	660
7/8/75	7:00	12500	20
8/6/75	11:00	13500	380
9/11/75	11:00	12000	350
10/16/75	12:00	10000	150
11/4/75	12:00	9270	20
3/3/76	11:00	18000	630
4/7/76	11:00	13200	85
5/4/76	13:00	10500	2500
6/3/76	11:00	9720	210
7/8/76	13:00	10400	300
8/4/76	11:00	8100	1500
9/7/76	12:00	8330	350
2/25/97	9:00		315
3/11/97	11:15		315
4/8/97	11:00		720
5/15/97	13:30		250
6/18/97	9:00		2400
7/7/97	12:35		4500
8/20/97	11:45		560
9/10/97	12:15		130
10/9/97	11:25		80
11/13/97	12:10		10
1/6/98	12:00	15500	6900
2/19/98	12:02	22700	1380
3/5/98	11:40	22100	280
5/12/98	12:10	8200	250
6/30/98	11:05	3100	4200
7/16/98	11:25	5900	6600
8/12/98	12:00	8050	390
10/6/98	12:05	3850	130
12/3/98	14:00	3200	280
1/13/99	11:45	15000	640
2/17/99	12:05	22100	60
3/3/99	12:30	19800	2700
4/1/99	12:20	11500	250
5/4/99	12:10	8200	140
6/9/99	11:30	4800	40
8/11/99	12:30	6200	140
9/1/99	13:10	6380	80
10/4/99	13:30	5050	240

Table 3. Continued

Date	Time	Flow (cfs)	Fecal Coliform (counts/100ml)
11/22/99	12:45	3000	155
12/8/99	12:10	2500	120
4/3/00	13:15	23500	2000
6/5/00	16:10	3200	420
7/11/00	14:45	2100	90
11/7/00	13:45		14
12/28/00	10:40		400

Table 4. Fecal Coliform Data at Station 28 for MSYAZR3M1
Summer Season, 2001

Date	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Violation	90^{th} Percentile	90^{th} Percentile Violation
9/28/2001	75	203	Yes	900	Yes
10/4/2001	50				
10/10/2001	**1200**				
10/15/2001	**600**				
10/18/2001	200				
10/24/2001	130				

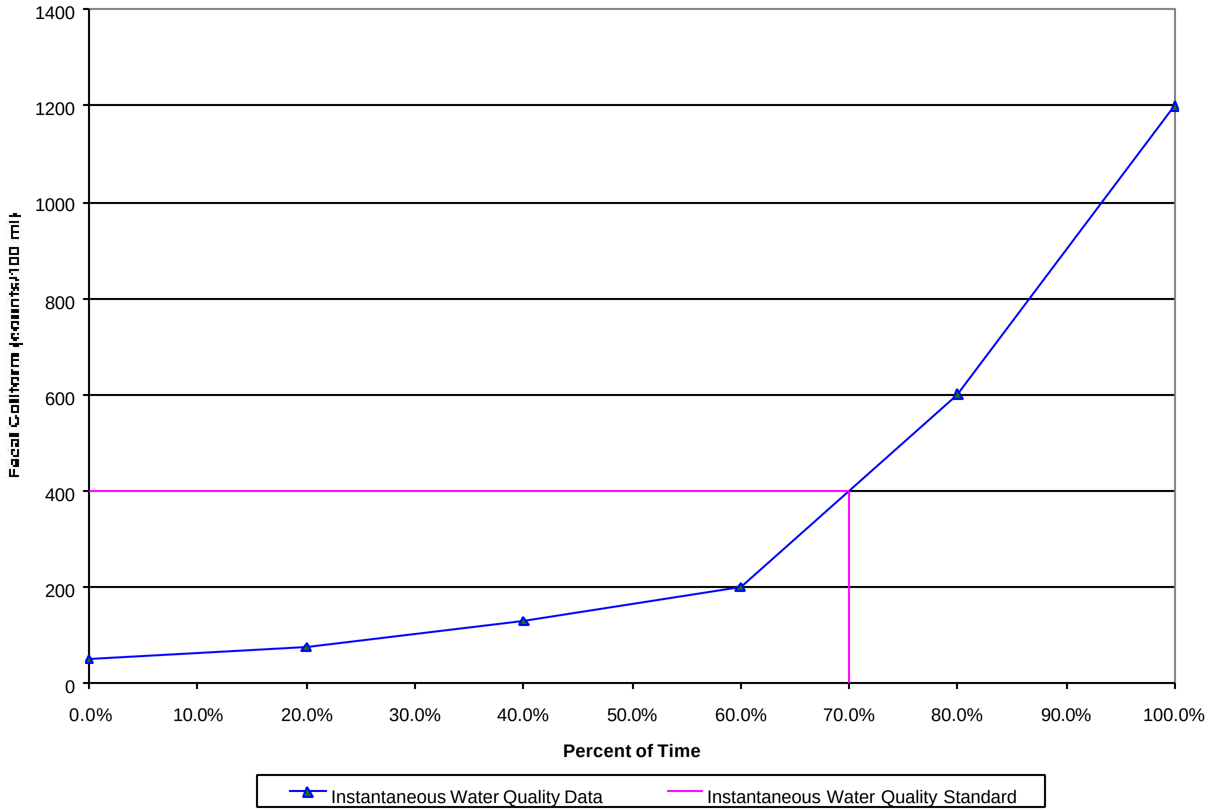
Table 5. Fecal Coliform Data at Station 28 for MSYAZR3M1
Winter Season, 2001

Date	Fecal Coliform (counts/100ml)	Geometric Mean	Geometric Mean Violation	90^{th} Percentile	90^{th} Percentile Violation
11/15/2001	83	353	No	2900	No
11/21/2001	84				
11/28/2001	**4100**				
12/3/2001	1700				
12/6/2001	190				
12/12/2001	210				

2.2.2 Analysis of Instream Water Quality Monitoring Data

The historical data collected by USGS can not be used to compare to the current fecal coliform standard. The data collected at station 28 during 2001 indicated, for the summer season, violation of the percent of time in exceedence and the geometric mean portion of the standard. The 90^{th} percentile of the summer data set is 900, which is greater than the 400 necessary to meet the standard. A graphical representation can be seen in Figure 8 below. A line has been added to the graph representing 400 counts/100 ml and showing that this occurs less than 90% of the time, meaning that the counts of fecal coliform in the stream is greater than 400 more than 10% of the time.

Figure 8. Statistical Representation of Water Quality Data for Station 28, Summer 2001



SOURCE ASSESSMENT

The TMDL evaluation summarized in this report examined all known potential fecal coliform sources in the Yazoo River Watershed. In evaluation of the sources, loads were characterized by the best available information, monitoring data, literature values, and local management activities. This section documents the available information and interpretation for the analysis.

3.1 Assessment of Point Sources

Point sources of fecal coliform bacteria have their greatest potential impact on water quality during periods of low flow. Thus, a careful evaluation of point sources that discharge fecal coliform bacteria was necessary in order to quantify the degree of impairment present during the low-flow, critical condition period

Once the permitted dischargers were located, the effluent was characterized based on all available monitoring data including permit limits, discharge monitoring reports, and information on treatment types. Discharge monitoring reports (DMRs) were the best data source for characterizing effluents because they report measurements of flow and fecal coliform present in effluent samples. If evidence of insufficient treatment existed or when data were not available, professional judgement was used to estimate a fecal coliform loading rate for the calculations. The facilities are shown in Table 6.

Table 6. Inventory of Point Source Dischargers

NPDES ID	Facility Name	Receiving Water	Design Flow (MGD)
MS0020371	Belzoni POTW	Yazoo River	1.3
MS0043346	Confish Inc	Yazoo River	0.134
MS0042315	Cruger POTW	Abiacha Creek	0.21
MS0040185	East Leflore County Water and Sewer District POTW, Chapman Subdivision	Jennings Bayou	0.02
MS0022705	East Leflore County Water and Sewer District, Rising Sun Subdivision	Pelucia Creek	0.16
MS0029203	Florewood State Park	Yazoo River	0.01
MS0048551	Freshwater Farms Inc	Yazoo River	0.28
MS0023833	Greenwood POTW	Yazoo River	6.32
MS0022594	Holmes County School District, Mileston Elementary School	Tchula Lake	0.012
MS0032620	Holmes County School District, Tchula and S V Marshall Attendance Center	Fannegusha Creek	0.016
MS0048003	Humphreys Academy Foundation, Humphreys Academy	Unnamed Ditch	0.008
MS0020915	Itta Bena POTW	Gayden Brake	0.5
MS0024601	Lexington POTW	Little Black Creek	0.5
MS0034169	Malouf Trailer Park	Pelucia Canal	0.04
MS0042641	Maryland Heights Trailer Park	Yazoo River	0.003
MS0024716	Morgan City Water and Sewer Association	Yazoo River	0.075
MS0024741	North Carrollton POTW	Big Sand Creek	0.1
MS0058301	Salvation Army, The, Camp Hidden Lake	Black Creek	0.013
MS0024724	Sidon POTW	Old Yazoo River	0.06
MS0044709	Silver City POTW	Big Cedar Creek	0.06
MS0057304	Southwest Developments Corporation, Rosebank Apartments	Fenneshuga Creek	0.01
MS0051098	T T and W Farm Products Inc	Yazoo River	1.394
MS0021482	Tchula POTW	Yazoo River	0.3
MS0043982	Tepper Headstart	Little Jackson Bayou	0.005
MS0030431	Vicksburg Warren School District, Redwood Elementary	Skillikalia Bayou	0.01
MS0020389	Yazoo City POTW	Yazoo River	3.0
MS0050261	Yazoo County High School	Short Creek	0.015

3.2 Assessment of Nonpoint Sources

There are many potential nonpoint sources of fecal coliform bacteria for Yazoo River, including:

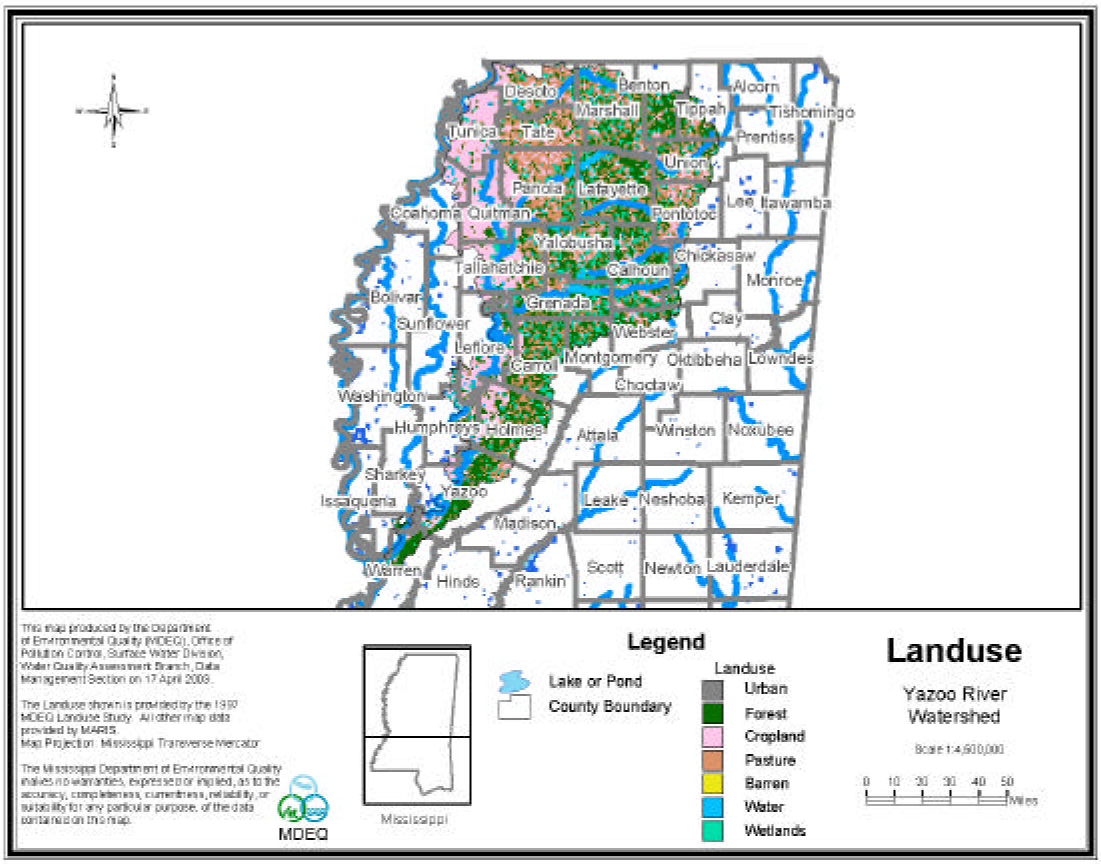
- Failing septic systems
- Wildlife
- Land application of hog and cattle manure
- Grazing animals
- Land application of poultry litter
- Other Direct Inputs
- Urban development

The 5,206,000 acre drainage area of the Yazoo River contains many different landuse types, including urban, forest, cropland, pasture, and wetlands. The landuse distribution for the watershed is provided in Table 7 and displayed in Figure 9. The landuse information for the watershed is based on the State of Mississippi's Automated Resource Information System (MARIS), 1997. This data set is based Landsat Thematic Mapper digital images taken between 1992 and 1993. The MARIS data are classified on a modified Anderson level one and two system with additional level two wetland classifications. The landuse categories were grouped into the landuses of urban, forest, cropland, pasture, barren, and wetlands.

Table 7. Landuse Distribution (acres)

	Urban	Forest	Cropland	Pasture	Barren	Wetland	Aquaculture	Water	Other	Total
Area (acres)	31,128	1,336,969	1,456,546	1,880,717	5,231	338,501	5,335	128,335	22,792	5,205,555
% Area	1%	26%	28%	36%	0%	7%	0%	2%	0%	100%

Figure 9. Landuse Distribution Map for the Yazoo River Watershed



The MARIS landuse data for Mississippi was utilized by the Watershed Characterization System (WCS) to extract landuse sizes, populations, and agriculture census data. MDEQ contacted several agencies to refine the assumptions made in determining the fecal coliform loading. The Mississippi Department of Wildlife, Fisheries, and Parks provided information of wildlife density in the Magees Creek Watershed. The Mississippi State Department of Health was contacted regarding the failure rate of septic tank systems in this portion of the state. Mississippi State University researchers provided information on manure application practices and loading rates for hog farms, poultry farms, and beef and dairy operations. The Natural Resources Conservation Service gave MDEQ information on agricultural manure treatment practices and land application of manure.

3.2.1 Failing Septic Systems

Septic systems have a potential to deliver fecal coliform bacteria loads to surface waters due to malfunctions, failures, and direct pipe discharges. Properly operating septic systems treat wastewater and dispose of the water through a series of underground field lines. The water is applied through these lines into a rock substrate, thence into underground absorption. The systems can fail when the field lines are broken, or when the underground substrate is clogged or flooded. A failing septic system's discharge can reach the surface, where it becomes available for wash-off into the stream. Another potential problem is a direct bypass from the system to a stream. In an effort to keep the water off the land, pipes are occasionally placed from the septic tank or the field lines directly to the creek.

Another consideration is the use of individual onsite wastewater treatment plants. These treatment systems are in wide use in Mississippi. They can adequately treat wastewater when properly maintained. However, these systems may not receive the maintenance needed for proper, long-term operation. These systems require some sort of disinfection to properly operate. When this expense is ignored, the water does not receive adequate disinfection prior to release.

Septic systems have an impact on nonpoint source fecal coliform impairment in the Yazoo River Basin. The best management practices needed to reduce this pollutant load need to prioritize eliminating septic tank failures and improving maintenance and proper use of individual onsite treatment systems.

3.2.2 Wildlife

Wildlife present in the Yazoo River Watershed contributes to fecal coliform bacteria on the land surface. It was assumed that the wildlife population remained constant throughout the year, and that wildlife were present on all land classified as pastureland, cropland, and forest. It was also assumed that the manure produced by the wildlife was evenly distributed throughout these land types.

3.2.3 Land Application of Hog Manure

In the Yazoo River Basin processed manure from confined hog operations is collected in lagoons and routinely applied to pastureland during April through October. This manure is a potential contributor of bacteria to receiving water bodies due to runoff produced during a rain event. Hog farms in the Pearl River Basin operate by keeping the animals confined at all times. The hog waste is collected in a lagoon and periodically sprayed on forage or cropland. The amount of the manure application is determined by the nitrogen uptake of the plant being sprayed. The frequency is determined by rain events so that the waste is not sprayed on saturated ground or just prior to a rain event to minimize runoff. Another factor in the application of the manure is pumping the lagoons often enough to avoid a lagoon overflow. Also, the waste is not land applied during the winter months when there is no forage or crop being grown. It was assumed that all of the hog manure produced was applied evenly to the available pastureland. Application rates of hog manure to pastureland from confined operations varied monthly according to management practices currently used in this area.

Large dairy farms, over 200 head, typically confine the milking herd at all times. Smaller dairy farms confine the lactating cattle for a limited time during the day for milking and feeding. The manure collected during confinement is applied to the available pastureland in the watershed. Like the hog farms, application rates of dairy cow manure to pastureland vary monthly according to management practices currently used in this area.

3.2.4 Beef and Dairy Cattle

Grazing cattle deposit manure on pastureland where it is available for wash-off and delivery to receiving water bodies. Beef cattle are assumed to have access to pastureland for grazing all of the time. For dairy cattle, the dry cattle and heifers are assumed to have access to pastureland for grazing all of the time. The small dairy farms, less than 200 head, in the Yazoo River Basin confine the lactating cattle for a limited time during the day. During all other times, the lactating cattle at small dairies are assumed to have access to pastureland for grazing. The milking herd is assumed to make up approximately 80% of the total herd. Manure produced by grazing beef and dairy cows is directly deposited onto pastureland and is available for wash off.

The manure produced by confined dairy cows is collected in lagoons and spray applied to available pastureland in the watershed. Large dairy farms, more than 200 head, typically confine the milking herd at all times. Smaller dairy farms confine the lactating cattle for a limited time during the day for milking and feeding. Like the hog farms, application rates of dairy cow manure to pastureland vary monthly according to management practices currently used in this area.

3.2.5 Land Application of Poultry Litter

Predominantly, two kinds of chickens are raised on farms in the Yazoo River Basin, broilers and layers. For the broiler chickens, the amount of growth time from when the chicken is born to when it is sold off the farm is approximately 48 days or 1.6 months. Broiler chickens are confined in poultry houses all of the time. A pine shaving litter material is used to contain broiler chicken waste. This dry waste accumulates and breaks down in the poultry houses. The poultry litter is removed from the houses approximately every two years but may remain as long as seven years. The majority of the litter is used as a fertilizer on hay and row crops and may be used in areas of the state other than the location of the poultry houses. The litter is applied in the spring, summer, and early fall and rates are determined by a phosphorous index. A small amount of the litter may be mixed in with cattle feed and is not land applied.

Layer chickens are confined at all times and remain on farms for ten months or longer. The waste from small scale layer operations is treated in the same way as broiler operations. Large scale layer operations collect the chicken waste in a lagoon and periodically spray apply the waste to corn fields. The application rates vary monthly from the spring through the early fall.

3.2.6 Other Direct Inputs

Due to the general topography in the Yazoo River Watershed, it was assumed that land slopes in the watershed are such that unconfined animals are able to access the intermittent streams in the watershed. This direct input of cattle manure represents all animal access to streams (domestic and wild), illicit discharges of fecal coliform bacteria, human recreation, and leaking sewer collection lines.

3.2.7 Urban Development

Urban areas include land classified as urban and barren. Even though only a small percentage of the watershed is classified as urban, the contribution of the urban areas to fecal coliform loading in the Yazoo River was considered. Fecal coliform contributions from urban areas may come from storm water runoff, failing sewer pipes, and runoff contribution from improper disposal of materials such as litter.

LOAD DURATION CURVE PROCEDURE

The methodology outlined in a paper completed to explore the use of load duration curves for data analysis applications for streams in the Yazoo River Basin in Mississippi was followed in the development of the load duration curves (Sheely, 2002). Load duration curves were developed as a method in which TMDLs applicable to all hydrological conditions could be calculated. Prior to the introduction of this method, many TMDLs were developed to address a single flow condition such as the 7Q10 (7-day, 10-year low flow) or average flow. This new method is innovative, because it allows for the development of TMDLs that addressed more than just a single flow condition. Because these curves include the entire range of flow conditions, pollutant sources of all types can be considered in the TMDLs. The methods used to develop both the flow and load duration curves will be described.

4.1 Development of Flow Duration Curves

The first step in the development of load duration curves is to create flow duration curves using continuous flow or stage data. For segment MSYAZR3M1, USGS continuous flow gage 07287000 was used with a drainage area weighting method. For segment MS400M, the limited flow data collected at USGS water quality station 07288800 was used. USGS continuous flow gage 07288955 was not used because it contains the influence of the Big Sunflower River and the differences in the drainage areas is too large to effectively use a drainage area weighting method.

The flow data are used to create flow duration curves, which display the cumulative frequency distribution of the daily flow data over the period of record. The flow duration curve relates flow values measured at the monitoring station to the percent of time that those values are met or exceeded. Flows are ranked from extremely low flows, which are exceeded nearly 100 percent of the time, to extremely high flows, which are rarely exceeded.

4.2 Development of Load Duration Curves

Flow duration curves are then transformed into load duration curves by multiplying the flow values along the curve by applicable water quality criteria values for pathogens and appropriate conversion factors. The load duration curves are conceptually similar to the flow duration curves, in that the x-axis represents the flow recurrence interval. The y-axis is transformed to represent the allowable load of the water quality parameter. The curve representing the allowable load of fecal coliform was calculated using the instantaneous, summer water quality criteria of 400 counts per 100 ml and the flow associated with each flow recurrence interval. Another load duration curve showing the target of 200 counts per 100 ml with a 50 percent MOS was also developed. The load duration curves developed for the two segments are included in Appendix A.

4.3 Comparison of Monitoring Data and Water Quality Criteria

The final step in the development of load duration curves was to add the monitoring data to the curves. Pollutant loads were estimated from the data as the product of the pollutant concentrations, instantaneous flows measured at the time of sample collection, and appropriate conversion factors. In order to identify the plotting position of each calculated load, the recurrence interval of each instantaneous flow measurement was defined. Water quality monitoring data are plotted on the same graph as the load duration curve. The load duration curves provide a graphical display of the water quality conditions in the waterbody. The monitoring data points that plot above the target line exceed the water quality target, while those that plot below meet the target.

4.4 Source Identification

The position at which the monitoring data exceed the target gives an indication of the potential sources and delivery mechanisms of the pollutants. Violations that occur on the right side of the curve, during low-flow conditions, indicate the presence of continuous pollutant sources, such as NPDES permitted discharges. Violations that occur on the left side of the curve, during higher flows, indicate intermittent sources that appear in response to rain events. Monitoring data that exceed water quality criteria in the mid-range flow indicate that pollutants are most likely due to a combination of these sources.

The load duration curves shown in Appendix A display only the water quality data points that exceed the target in each segment. The interpretation of those curves indicate that both point and nonpoint sources are present in the Yazoo River Watershed.

Using load duration curves for data analysis is different from the methods typically used for data analysis in that the frequency of attainment or violation of a particular water quality criteria is stressed rather than the absolute values of the monitoring data. One of the strengths of this method is that it can be used to interpret possible delivery mechanisms of pollutants. Load duration curves discussed have been shown to be influenced by the landuse distribution in their watersheds (Sheely, 2002). Because of this, load duration curves have the potential to be used as a method for targeting pollution reduction efforts in watersheds that are impaired and require TMDL development. Another strength of load duration curves is that they provide an understandable, graphical explanation of the data that are available for a monitoring station.

4.5 Selection of Representative Period

The period of record for flow data ranged from 1907 to 2001. The period of record for water quality data ranged from 1976 to 2001. Seasonality and critical conditions are accounted for during the extended time frame of the data represented in the load duration curves.

The critical condition for fecal coliform impairment from nonpoint source contributors occurs after a heavy rainfall that is preceded by several days of dry weather. The dry weather allows a build up of fecal coliform bacteria, which is then washed off the ground by a heavy rainfall. By using the extended time period, many such occurrences should be captured in the data results. Critical conditions for point sources, which occur during low-flow and low-dilution conditions, are considered as well.

4.6 Existing Loading

Appendix A includes graphs of the load duration curves showing the instream fecal coliform loads for both of the Yazoo River segments included in this TMDL. The graph shows a regression line through the data points that exceed the 200 counts per 100 ml target. The regression line represents the best fit of the existing loading in the Yazoo River.

ALLOCATION

In accordance with 40 CFR Section 130.2, which states, "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure," this TMDL is expressed as a percent reduction of load in order to retain the benefit of utilizing various flow conditions to develop the load duration curve. The use of a single TMDL number would effectively return to the choice of just one flow condition for TMDL development. This method uses the difference between the regression line through the exceeding points and the load duration target curve to calculate the appropriate percent reduction necessary for the TMDL. The only allocation included in this TMDL is the wasteload allocation for point sources.

5.1 Wasteload Allocations

The wasteload allocation is based on the existing point sources in the Yazoo River Watershed. The WLA is represented on the Load Duration Curves in Appendix A as a horizontal line with a constant load appropriate for each segment. Due to the large number of point sources in the Yazoo River Watershed and the absence of the ability to represent die-off of fecal coliform using the load duration curve method, the WLA makes up a large percentage of the TMDLs in this report. The point sources and their allocated load are shown in Table 8. The point sources that are recommended for permit modification to include fecal coliform limits and disinfection are also indicated in Table 8.

Table 8. Wasteload Allocations

NPDES ID	Facility Name	Allocated Load (counts/day)	Permit Modification Necessary
MS0020371	Belzoni POTW	1.97E+10	No
MS0043346	Confish Inc	2.03E+09	No
MS0042315	Cruger POTW	3.18E+09	No
MS0040185	East Leflore County Water and Sewer District POTW, Chapman Subdivision	3.03E+08	Yes
MS0022705	East Leflore County Water and Sewer District, Rising Sun Subdivision	2.42E+09	Yes
MS0029203	Florewood State Park	1.51E+08	No
MS0048551	Freshwater Farms Inc	4.24E+09	No
MS0023833	Greenwood POTW	9.57E+10	No
MS0022594	Holmes County School District, Mileston Elementary School	1.82E+08	No
MS0032620	Holmes County School District, Tchula and S V Marshall Attendance Center	2.42E+08	No
MS0048003	Humphreys Academy Foundation, Humphreys Academy	1.21E+08	Yes
MS0020915	Itta Bena POTW	7.57E+09	Yes
MS0024601	Lexington POTW	7.57E+09	No
MS0034169	Malouf Trailer Park	6.06E+08	No
MS0042641	Maryland Heights Trailer Park	4.54E+07	Yes
MS0024716	Morgan City Water and Sewer Association	1.14E+09	Yes
MS0024741	North Carrollton POTW	1.51E+09	Yes
MS0058301	Salvation Army, The, Camp Hidden Lake	1.97E+08	Yes
MS0024724	Sidon POTW	9.09E+08	No
MS0044709	Silver City POTW	9.09E+08	No
MS0057304	Southwest Developments Corporation, Rosebank Apartments	1.51E+08	No
MS0051098	T T and W Farm Products Inc	2.11E+10	No
MS0021482	Tchula POTW	4.54E+09	No
MS0043982	Tepper Headstart	7.57E+07	No
MS0030431	Vicksburg Warren School District, Redwood Elementary	1.51E+08	No
MS0020389	Yazoo City POTW	4.54E+10	No
MS0050261	Yazoo County High School	4.54E+10	No
Total		**2.66E+11**	

5.2 Load Allocations

The load allocation for this TMDL varies according to the flow conditions as represented graphically for each segment in Graphs A-1, and A-2.

5.3 Incorporation of a Margin of Safety (MOS)

The two types of MOS development are to implicitly incorporate the MOS using conservative assumptions or to explicitly specify a portion of the total TMDL as the MOS. For this TMDL, the MOS is an explicit 50 percent reduction of the criteria of 400 counts per 100 ml to a target of 200 counts per 100 ml.

5.4 Calculation of the TMDL

Because the TMDL is variable depending on the recurrence interval of the appropriate flow, the TMDL is expressed as an average percent reduction of the load. The percent reduction necessary for the TMDL is the average of the differences between the existing load line and the target load curve at each recurrence interval. The regression line through the exceeding points represents the existing load. The target curve represents the 200 counts per 100 ml at the various flows. Graphs A-1, and A-2 graphically represent the variable TMDL and LA, WLA and MOS for each segment. The percent reduction of fecal coliform bacteria recommended for each segment in this TMDL is shown in Table 9. The units of counts per day are appropriate for this TMDL due to the use of the instantaneous standard as opposed to units of counts/per 30 days that are used in conjunction with the use of the geometric mean standard. Based on the available information, as represented in Graphs A-1 and A-2, the percent reductions recommended in this TMDL will achieve the water quality standard for fecal coliform in each segment.

Table 9. TMDL Percent Reduction

Segment	WLA (counts/day)	MOS	TMDL Percent Reduction
MSYAZR3M1	8.04E+10	Explicit	40
MS400M	1.10E+11	Explicit	39

5.5 Seasonality

For many streams in the state, fecal coliform limits vary according to the seasons. This stream is designated for the use of secondary contact. For this use, the pollutant standard is seasonal. The criteria for the most critical season, which is the summer for the Yazoo River as shown in Figure 7, was used as the target for this TMDL.

Because data were used throughout the year for several years at each station, seasonality was addressed. The extended period of record for the flow information allowed for representation of many different flow conditions, which is also relevant to seasonality.

5.6 Reasonable Assurance

This component of TMDL development does not apply to this TMDL Report. There are no point sources (WLA) requesting a reduction based on promised Load Allocation components and reductions. This TMDL will recommend that all point sources discharge treated and disinfected effluent that will be below the 200 colony counts per 100-ml. target at the end of the pipe.

CONCLUSION

This TMDL requires a 40 percent reduction for segment MSYAZR3M1 and a 39 percent reduction for segment MS400M. The fecal coliform reduction scenario used in this TMDL included requiring all NPDES Permitted dischargers of bacteria to meet water standards for fecal coliform. Based on available information and the assumptions applied in developing this TMDL, the allocations if achieved will result in the attainment of the fecal coliform water quality standard in each segment.

The TMDL will not impact existing or future NPDES Permits as long as the effluent is disinfected to meet water quality standards for fecal coliform. MDEQ will not approve any NPDES Permit application that does not plan to meet water quality standards for disinfection. Education projects that teach best management practices should be used as a tool for reducing nonpoint source contributions. These projects may be funded by CWA Section 319 Nonpoint Source (NPS) Grants.

6.1 Future Monitoring

MDEQ has adopted the Basin Approach to Water Quality Management, a plan that divides Mississippi's major drainage basins into five groups. During each yearlong cycle, MDEQ resources for water quality monitoring will be focused on one of the basin groups. During the next monitoring phase in the Yazoo River Basin, the Yazoo River may receive additional monitoring to identify any change in water quality. MDEQ produced guidance for future Section 319 project funding will encourage NPS restoration projects that attempt to address TMDL related issues within Section 303(d)/TMDL watersheds in Mississippi.

Due to the extensive interest in the Yazoo River and to the magnitude of the violations shown in the recent monitoring the fecal coliform monitoring being conducted in the Yazoo River has been extended. Additional stations were added in the upstream areas showing the greatest magnitude violations. Also, the Mississippi State Department of Health under contract with MDEQ will be conducting surveys for failing or inadequate septic systems in the Yazoo River Watershed attempting to identify the sources of the violations.

6.2 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper and a newspaper in the area of the watershed. The public will be given an opportunity to review the TMDL and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. TMDL mailing list members may request to receive the TMDL reports through either, email or the postal service. Anyone wishing to be included on the TMDL mailing list should contact Greg Jackson at (601) 961-5098 or Greg_Jackson@deq.state.ms.us. At the end of the 30-day period, MDEQ will determine the level of interest in the TMDL and make a decision on the necessity of holding a public meeting. All written comments received during the public notice period and at any public meeting become a part of the record of this TMDL. All comments will be considered in the ultimate completion of this TMDL for submission of this TMDL to EPA Region 4 for final approval.

DEFINITIONS

Ambient stations: a network of fixed monitoring stations established for systematic water quality sampling at regular intervals, and for uniform parametric coverage over a long-term period.

Assimilative capacity: the capacity of a body of water or soil-plant system to receive wastewater effluents or sludge without violating the provisions of the State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality regulations.

Background: the condition of waters in the absence of man-induced alterations based on the best scientific information available to MDEQ. The establishment of natural background for an altered waterbody may be based upon a similar, unaltered or least impaired, waterbody or on historical pre-alteration data.

Calibrated model: a model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.

Critical Condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a waterbody have their greatest potential for adverse effects.

Daily discharge: the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average.

Designated Use: use specified in water quality standards for each waterbody or segment regardless of actual attainment.

Discharge monitoring report: report of effluent characteristics submitted by a NPDES Permitted facility.

Effluent standards and limitations: all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.

Effluent: treated wastewater flowing out of the treatment facilities.

Fecal coliform bacteria: a group of bacteria that normally live within the intestines of mammals, including humans. Fecal coliform bacteria are used as an indicator of the presence of pathogenic organisms in natural water.

Geometric mean: the *n*th root of the product of *n* numbers. A 30-day geometric mean is the 30^{th} root of the product of 30 numbers.

Impaired Waterbody: any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.

Land Surface Runoff: water that flows into the receiving stream after application by rainfall or irrigation. It is a transport method for nonpoint source pollution from the land surface to the receiving stream.

Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant. The load allocation is the value assigned to the summation of all direct sources and land applied fecal coliform that enter a receiving waterbody. It also contains a portion of the contribution from septic tanks.

Loading: the total amount of pollutants entering a stream from one or multiple sources.

Nonpoint Source: pollution that is in runoff from the land. Rainfall, snowmelt, and other water that does not evaporate become surface runoff and either drains into surface waters or soaks into the soil and finds its way into groundwater. This surface water may contain pollutants that come from land use activities such as agriculture; construction; silviculture; surface mining; disposal of wastewater; hydrologic modifications; and urban development.

NPDES permit: an individual or general permit issued by the Mississippi Environmental Quality Permit Board pursuant to regulations adopted by the Mississippi Commission on Environmental Quality under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

Point Source: pollution loads discharged at a specific location from pipes, outfalls, and conveyance channels from either wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream.

Pollution: contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the Permit Board.

Publicly Owned Treatment Works (POTW): a waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Regression Coefficient: an expression of the functional relationship between two correlated variables that is often empirically determined from data, and is used to predict values of one variable when given values of the other variable.

Scientific Notation (Exponential Notation): mathematical method in which very large numbers or very small numbers are expressed in a more concise form. The notation is based on powers of ten. Numbers in scientific notation are expressed as the following: *4.16 x 10^(+b)* and *4.16 x 10^(-b) [same as 4.16E4 or4.16E-4]*. In this case, *b* is always a positive, real number. The *10^(+b)* tells us that the decimal point is *b* places to the right of where it is shown. The *10^(-b)* tells us that the decimal point is *b* places to the left of where it is shown.
For example: $2.7X10^{4}$ = 2.7E+4 =27000 and $2.7X10^{-4}$ = 2.7E-4=0.00027.

Sigma (S): shorthand way to express taking the sum of a series of numbers. For example, the sum or total of three amounts 24, 123, 16, ($\mathbf{d_1}$, $\mathbf{d_2}$, $\mathbf{d_3}$) respectively could be shown as:

$$\sum_{i=1}^{3} d_i = d_1+d_2+d_3 = 24+123+16 = 163$$

Total Maximum Daily Load or TMDL: the calculated maximum permissible pollutant loading to a waterbody at which water quality standards can be maintained.

Waste: sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA): the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant. It also contains a portion of the contribution from septic tanks.

Water Quality Standards: the criteria and requirements set forth in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Mississippi antidegradation policy.

Water quality criteria: elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

Waters of the State: all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean Water Act (33 U.S.C.1251 et seq.).

Watershed: the area of land draining into a stream at a given location.

ABBREVIATIONS

7Q10................................Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period

BASINS.. Better Assessment Science Integrating Point and Nonpoint Sources

BMP ....Best Management Practice

CWA ....Clean Water Act

DMR..Discharge Monitoring Report

EPA ....Environmental Protection Agency

GIS ....Geographic Information System

HUC ....Hydrologic Unit Code

LA..Load Allocation

MARIS .... State of Mississippi Automated Information System

MDEQ .... Mississippi Department of Environmental Quality

MOS..Margin of Safety

NRCS ....National Resource Conservation Service

NPDES ....National Pollution Discharge Elimination System

NPSM..Nonpoint Source Model

RF3..Reach File 3

USACE..United States Army Corps of Engineers

USGS..United States Geological Survey

WLA..Waste Load Allocation

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APPENDIX A

This appendix contains the load duration curves for the three areas included in this TMDL. Graph A-1 shows the load duration curve near Shell Bluff for Station 07287120. This load duration curve is relevant to the TMDL calculation for segment MSYAZR3M1. Graph A-2 shows the load duration curve near Redwood for Station 07288800. This load duration curve is relevant to the TMDL calculation for segment MS400M.

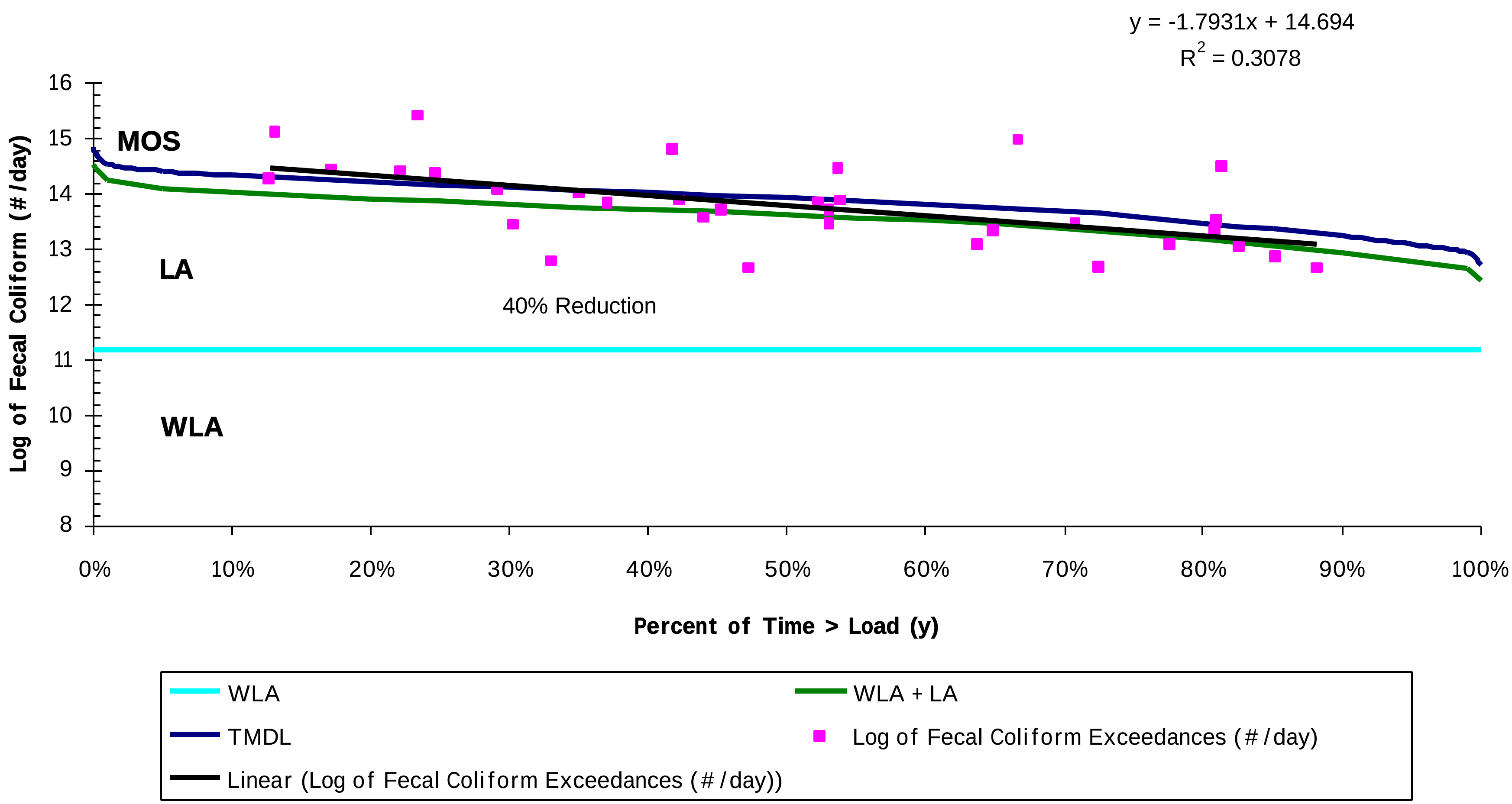
Graph A-1

Yazoo River Segment MSYAZR3M1

Load Duration Curve for Fecal Coliform Bacteria

DA Ratio Based on USGS Flow Gage 07287000

Monitoring Data from Station 07287120



Graph A-2

Yazoo River Segment MS400M

Load Duration Curve for Fecal Coliform Bacteria

USGS Flow Gage 07288800

Monitoring Data from Station 07288800